

THE COST-EFFICIENT GROUND IMPROVEMENT IN SEVERE AND ADVERSE CONDITIONS

The P.E.R. (Pressurizing Element for Reinforcement) Ground System is a fully implementable, multipurpose, high performance soil nail solution which targets both ground reinforcement and drainage applications.

The system can be effectively implemented in loose, swelling or ravelling ground and to address stringent requirements in underground water control.

The innovative system has been engineered to deal with adverse and severe ground conditions. It is customizable to deliver combinations of strengthening, dissipation of water pore pressure and weathertightness.

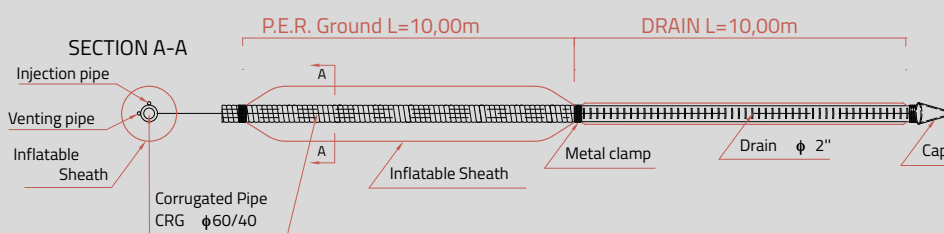
P.E.R. Ground system and its unique features enable direct benefits to the tunnel work progress:

- M** Stabilisation and improvement of excavation face conditions;
- M** Reduced construction time, both in installation and grouting works;
- M** Reduced and controlled deformation and settlement which may be detrimental to the tunnel work progress.

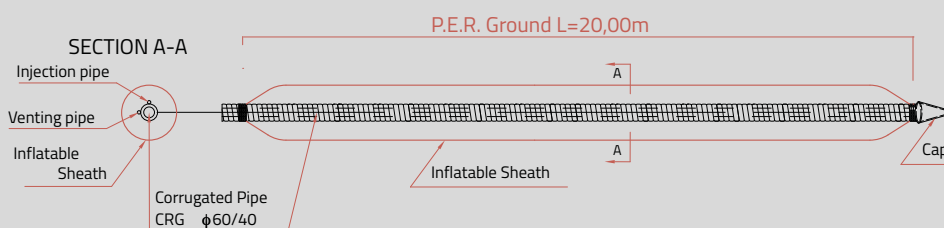
The product may be customized when used in core-consolidation face applications:

- M** Micro-slotted HDPE pipe, and non-woven geotextile, to allow recompression of the ground and drainage simultaneously;
- M** Slotted PVC pipe (manchette pipe), to allow recompression of the ground and either permeation, or pressure grouting simultaneously.

P.E.R. GROUND ELEMENT - TYPE "f1" FOR REINFORCEMENT & DRAINAGE

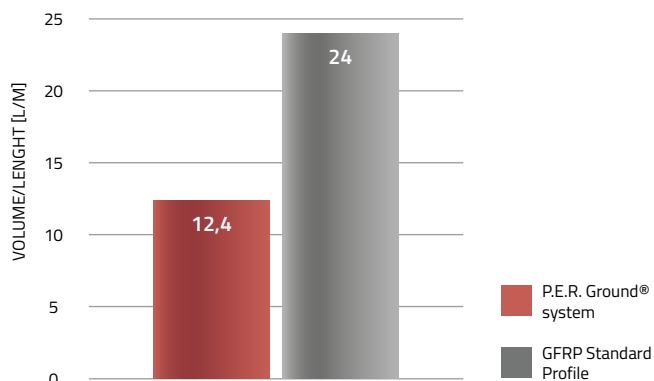


P.E.R. GROUND ELEMENT - TYPE "f2" FOR REINFORCEMENT



Two different types of P.E.R.Ground: type "f1" for both reinforcement and drainage and type "f2" for reinforcement only

P.E.R. GROUND SYSTEM



Grouting Volume Control
(injected volume of grout [l] per metre of nail [m])

P.E.R. Ground System features a fibreglass reinforcement element, with an expanding sheath. Once the system is installed, the sheath is grouted at pressure. This enhances **pull-out resistance**, and enables the **re-compression of the surrounding** ground whilst confining the grout within the sheath resulting in grouting volume control. The injected volume of grout in P.E.R. Ground system is less than the traditional GFRP Standard profile.

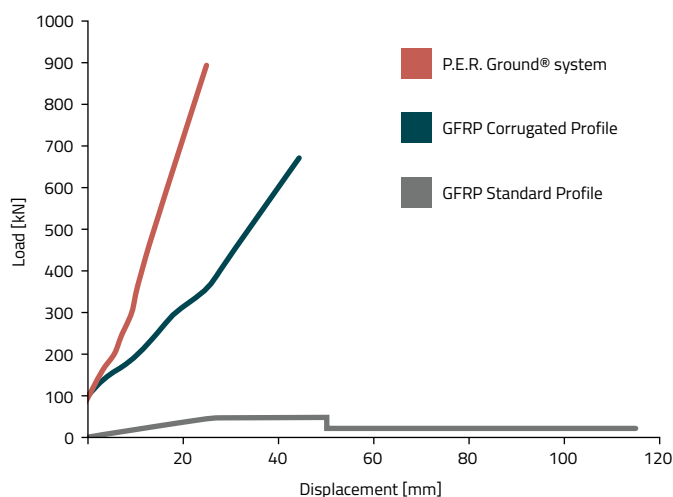
Technical advantages on anchorage between element and ground in P.E.R.Ground :

- M** Mortar confined within the sheath, which provides an area of adherence wider than ordinary fiberglass elements;
- M** Pressurized sheath that expands generating compaction of the ground surrounding the borehole;
- M** The associated increase of radial pressure can be accounted for as an increase of apparent cohesion.



Expansion of a P.E.R. Ground (R) bar after injection

Pull-out tests were conducted on site in the Timpa delle Vigne with the aim of assessing the bonding proprieties in real job-site conditions. The test results showed a significantly higher pull-out resistance (over 850 kN) compared to conventional GFRP pipes both with standard and corrugated profiles.



Pull-out test results

Officine Maccaferri S.p.A.
Via J.F. Kennedy, 10
40069 Zola Predosa (Bologna) - Italy
T: + (39) 051 643 6000
E: info@hq.maccaferri.com

maccaferri.com